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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/888,642	06/26/2001	Toshio Haba	500.40269X00	9091

20457 7590 03/25/2004

ANTONELLI, TERRY, STOUT & KRAUS, LLP
1300 NORTH SEVENTEENTH STREET
SUITE 1800
ARLINGTON, VA 22209-9889

EXAMINER

WONG, EDNA

ART UNIT	PAPER NUMBER
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1753

DATE MAILED: 03/25/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/888,642

Applicant(s)

HABA ET AL.

Examiner

Edna Wong

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 17 February 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-5 and 7-24 is/are pending in the application.
- 4a) Of the above claim(s) 1,2,4,5,7,8,10 and 11 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 3,9 and 12-24 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

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This is in response to the Amendment dated February 17, 2004. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Response to Arguments

Election/Restrictions

Applicants state that claim 13 is generic ("Remarks", page 17, line 1).

The Examiner disagrees because if the species are:

- (a) cyanine dyes,
- (b) indolium compounds and
- (c) compounds represented by the formula I,

as indicated on page 2 of the Examiner's Restriction Requirement dated August 20, 2003, and claim 13 specifically recites all of these species, how can claim 13 be generic then?

The requirement is still deemed proper and is therefore made FINAL.

This application contains claims **1-2, 4-5, 7-8 and 10-11** drawn to an invention nonelected without traverse in the Amendment dated September 22, 2003. A complete reply to the final rejection must include cancelation of nonelected claims or other appropriate action (37 CFR 1.144) See MPEP § 821.01.

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Specification

The disclosure has been objected to because of minor informalities.

The objection to the disclosure has been withdrawn in view of Applicants' amendment.

Claim Rejections - 35 USC § 112

I. Claim **13** has been rejected under 35 U.S.C. 112, first paragraph.

The rejection of claim 13 under 35 U.S.C. 112, first paragraph, has been maintained for the following reasons:

The phrase "**additives** [*plural emphasis*] selected from the group consisting of" still makes the claim open to using a cyanine dye, an indolium compound **and** a compound represented by formula I.

There is no disclosure in the specification for using a cyanine dye, an indolium compound **and** a compound represented by formula I altogether in one bath as presently claimed. Thus, claim 13 is still not commensurate in scope with Applicants' specification.

II. Claims **3, 6, 9, 12 and 13** have been rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The rejection of claims 3, 6, 9, 12 and 13 under 35 U.S.C. 112, second

paragraph, has been withdrawn in view of Applicants' amendment.

Claim Rejections - 35 USC § 102

I. Claim **3** has been rejected under 35 U.S.C. 102(b) as being anticipated by **Gerenrot et al.** ("Effect of the Structure of Carbocyanine Dyes on the Leveling Power During the Electrodeposition of Copper", *Zashchita Metallov* (1972), Vol. 8, No. 3, pp. 338-342).

The rejection of claim 3 under 35 U.S.C. 102(b) as being anticipated by Gerenrot et al. has been withdrawn in view of Applicants' amendment.

II. Claim **13** has been rejected under 35 U.S.C. 102(b) as being anticipated by **Gerenrot et al.** ("Effect of the Structure of Carbocyanine Dyes on the Leveling Power During the Electrodeposition of Copper", *Zashchita Metallov* (1972), Vol. 8, No. 3, pp. 338-342).

The rejection of claim 13 under 35 U.S.C. 102(b) as being anticipated by Gerenrot et al. has been withdrawn in view of Applicants' amendment.

Claim Rejections - 35 USC § 103

I. Claims **6 and 9** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Gerenrot et al.** ("Effect of the Structure of Carbocyanine Dyes on the Leveling Power During the Electrodeposition of Copper", *Zashchita Metallov* (1972),

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Vol. 8, No. 3, pp. 338-342) as applied to claim 3 above, and further in view of **Barstad et al.** (US Patent No. 6,444,110 B2).

The rejection of claims 6 and 9 under 35 U.S.C. 103(a) as being unpatentable over Gerenrot et al. as applied to claim 3 above, and further in view of Barstad et al. has been withdrawn in view of Applicants' amendment.

II. Claim **12** has been rejected under 35 U.S.C. 103(a) as being unpatentable over **Landau** (US Patent No. 6,261,433 B1) in combination with **Gerenrot et al.** ("Effect of the Structure of Carbocyanine Dyes on the Leveling Power During the Electrodeposition of Copper", *Zashchita Metallov* (1972), Vol. 8, No. 3, pp. 338-342).

The rejection of claim 12 under 35 U.S.C. 103(a) as being unpatentable over Landau in combination with Gerenrot et al. has been withdrawn in view of Applicants' amendment.

Response to Amendment

Claim Objections

Claims **3, 9, 13, 17 and 19** are objected to because of the following informalities:

Claim 3

lines 1-2, it is suggested that the words "A copper electroplating bath comprising a solution containing" be amended to the words -- A copper electroplating solution containing -- because it appears that the bath and the solution are the same entity. If it

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is not, then what is the difference between the bath and the solution. Also, how does the bath comprise a solution?

line 2, it is suggested that the words "at least one of electrolytes" be amended to the words -- at least one electrolyte --.

line 5, it is suggested that the word "of" be deleted.

lines 5-7, the limitation of "wherein one or more polyethers, organic sulfur compounds and halide ions is further added to said copper electroplating bath" is a process limitation. It is suggested that the word "and" in line 2 be deleted and the limitation be amended to -- and one or more polyethers, organic sulfur compounds and halide ions --.

Claim 9

lines 2-3, the limitation of "and wherein said at least one of the compounds of the general formula (I) is added" is a process limitation. It is suggested that the limitation be amended to -- and wherein said at least one of the compounds of the general formula (I) is present --.

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Claim 13

lines 1-2, it is suggested that the words "A copper electroplating bath comprising a solution containing" be amended to the words -- A copper electroplating solution containing -- because it appears that the bath and the solution are the same entity. If it is not, then what is the difference between the bath and the solution. Also, how does the bath comprise a solution?

line 2, it is suggested that the words "at least one of electrolytes" be amended to the words -- at least one electrolyte --.

line 3, it is suggested that the words "at least one of cyanine dyes" be amended to the words -- at least one cyanine dye --.

line 4, it is suggested that the words "at least one of indolium compounds" be amended to the words -- at least one indolium compound --.

line 7, it is suggested that the word "of" be deleted.

lines 7-9, the limitation of "and wherein one or more polyethers, organic sulfur compounds and halide ions is further added to said copper electroplating bath" is a process limitation. It is suggested that the word "and" in line 2 be deleted and the

limitation be amended to -- and one or more polyethers, organic sulfur compounds and halide ions --.

Claim 17

lines 1-2, the limitation of "wherein at least one polyether is added to said copper electroplating bath" is a process limitation. It is suggested that the limitation be amended to -- further containing said one or more polyethers --. See also claim 18, line 2.

Claim 19

lines 1-2, the limitation of "wherein at least one organic sulfur compound is added to the copper electroplating bath" is a process limitation. It is suggested that the limitation be amended to -- further containing said one or more organic sulfur compounds --. See also claim 20, lines 1-2.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

Claims **15-22 and 24** are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 15

line 2, "the electroplating reaction" lacks antecedent basis. See also claim 15,
line 3.

Claim 16

line 3, "the electroplating reaction" lacks antecedent basis. See also claim 16,
line 4.

Claim 17

lines 1-2, it appears that the "at least one polyether" is further limiting the one or
more polyethers recited in claim 3, line 5. However, it is unclear if it is.

Claim 19

lines 1-2, it appears that the "at least one organic sulfur compound" is further
limiting the organic sulfur compounds recited in claim 3, line 6. However, it is unclear if it
is.

Claim 21

line 8, "the electroplating reaction" lacks antecedent basis. See also claim 21,
line 9.

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Claim 22

line 7, it is unclear which additives "said additives" are further limiting. Is it the additives recited in claim 13, lines 2-7, or the further added components recited in claim 13, lines 8-9?

lines 7-8, "the electroplating reaction" lacks antecedent basis.

Claim 24

lines 1-2, , it is unclear which additives "said additives" are further limiting. Is it the additives recited in claim 13, lines 2-7, or the further added components recited in claim 13, lines 8-9?

Claim Rejections - 35 USC § 103

Bath

I. Claims **3, 9 and 16-19** are rejected under 35 U.S.C. 103(a) as being unpatentable over **King et al.** (US Patent No. 5,174,886) in combination with **Gerenrot et al.** ("Effect of the Structure of Carbocyanine Dyes on the Leveling Power During the Electrodeposition of Copper", *Zashchita Metallov* (1972), Vol. 8, No. 3, pp. 338-342).

King teaches a copper electroplating solution comprising:

- (a) copper ions ($= \text{CuSO}_4 \cdot 5\text{H}_2\text{O}$);
- (b) at least one electrolyte ($= \text{H}_2\text{SO}_4$); and

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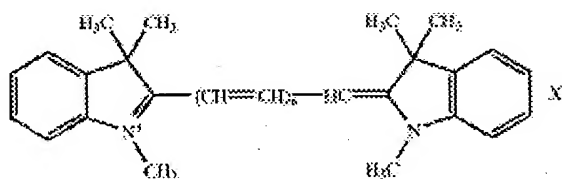
(c) one or more of polyethers (= polyethylene glycol), organic sulfur compounds (= conventional brightening additive) [col. 3, line 55 to col. 4, line 16] and halide ions (= chloride) [col. 6, lines 18-32].

At least one polyether is added to said copper electroplating bath (= polyethylene glycol) [col. 6, lines 18-32].

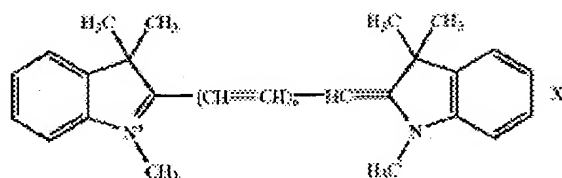
The at least one polyether is polyethylene glycol having an average molecular weight of 1,000 to 10,000 (= polyethylene glycol, M.W. 8,000) [col. 6, lines 18-32].

At least one organic sulfur compound is added to the copper electroplating bath (= conventional brightening additive) [col. 3, line 55 to col. 4, line 16].

King does not teach at least one of the compounds represented by the following general formula:



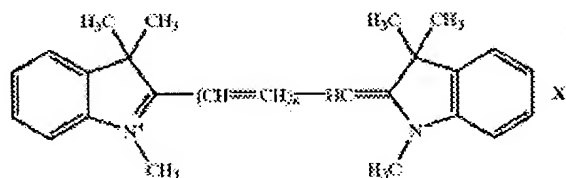
However, Gerenrot teaches a carbocyanine dye having the formula:



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as a leveling agent in a copper electroplating solution (abstract; and page 339, Table, dye No. 5).

Thus, the invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the copper electroplating bath of King by using a carbocyanine dye having the formula:



as the leveling agent because King teaches that the high throw acid copper plating baths contain a conventional leveling agent. The choice of leveling agent is not critical to the performance of the plating baths and may be chosen from a variety of leveling additives disclosed in the prior art (col. 3, line 55 to col. 4, line 16).

A conventional leveling agent is the carbocyanine dye taught by Gerenrot (abstract; and page 339, Table, dye No. 5) and to use the carbocyanine dye taught by Gerenrot in the copper electroplating solution of King would have been functionally equivalent and well within the skill of the artisan to use.

As to wherein said at least one of the compounds represented by the following general formula (I) is added at a concentration of 1 to 15 mg/L, the concentration of the compounds of the general formula (I) is a result-effective variable and one skilled in the

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art has the skill to calculate the concentration that would determine the success of the desired reaction to occur, e.g., leveling, absent evidence to the contrary. MPEP § 2141.03 and § 2144.05(b).

Gerenrot teaches 5×10^{-6} , 5×10^{-5} or 5×10^{-4} M of the leveling additive (abstract).

As to wherein said at least one of the compounds represented by the general formula (I) suppresses the electroplating reaction during use of the copper electroplating bath and is consumed as the electroplating reaction proceeds, and a diffusion rate thereof is lower than a rate of reaction thereof during the use of the copper electroplating bath, it has been held that a newly discovered use or function of components does not necessarily mean the system is unobvious since this use or function may be inherent in the prior art. *Ex parte Pfeiffer* 135 USPQ 31.

Furthermore, this limitation does not compositionally distinguish the bath from the prior art. This is a result from carrying out the method of use.

II. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over **King et al.** (US Patent No. 5,174,886) in combination with **Gerenrot et al.** ("Effect of the Structure of Carbocyanine Dyes on the Leveling Power During the Electrodeposition of Copper", *Zashchita Metallov* (1972), Vol. 8, No. 3, pp. 338-342) as applied to claims 3, 9 and 16-19 above, and further in view of **Barbieri et al.** (US Patent No. 4,555,315) and **Barstad et al.** (US Patent No. 6,444,110 B2).

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Gerenrot is as applied above and incorporated herein.

Gerenrot does not teach wherein said at least one organic sulfur compound is selected from the group consisting of 3-mercapto-1-propanesulfonic acid, 2-mercapto ethane sulfonic acid, bis (4-sulfobutyl) disulfide, bis (3-sulfopropyl) disulfide, bis (2-sulfoethyl) disulfide and bis (p-sulfophenyl) disulfide.

However, Barstad teaches that high brightener concentrations can accelerate the plating rate in recesses and microvias as carrier molecules become incorporated into plating deposit (col. 2, lines 55-62) and that the use of a suppressor agent in combination with elevated brightener concentrations can result in effective "bottom-fill" copper plating of microvias or other aperture without defects such as inclusions or voids (col. 3, lines 20-30). The brightener has the formula $R'-S-R-SO_3X$ (col. 5, lines 3-67) and the suppressor agent has the formula $R-O-(CXYCX'Y'O)_nH$ (col. 6, lines 23-38).

Thus, the invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the bath of King with wherein said at least one organic sulfur compound is selected from the group consisting of 3-mercapto-1-propanesulfonic acid, 2-mercapto ethane sulfonic acid, bis (4-sulfobutyl) disulfide, bis (3-sulfopropyl) disulfide, bis (2-sulfoethyl) disulfide and bis (p-sulfophenyl) disulfide because King teaches that the high throw acid copper plating

baths contain a conventional brightening additive. The choice of brightening additive is not critical to the performance of the plating baths and may be chosen from a variety of brightening additives disclosed in the prior art, such as in US Patent No. 4,555,315 (col. 3, line 55 to col. 4, line 16). US Patent No. 4,555,315 (Barbieri et al.) teaches polysulfide compounds having the formula $XR_1-(S)_nR_2SO_3H$ or $XR_1-(S)_nR_2PO_3H$ (col. 3, lines 25-43). These organic sulfur compounds are known brighteners in copper electroplating baths as taught by Barstad (col. 5, lines 3-67).

III. Claims **13 and 15** are rejected under 35 U.S.C. 103(a) as being unpatentable over **King et al.** (US Patent No. 5,174,886) in combination with **Gerenrot et al.** ("Effect of the Structure of Carbocyanine Dyes on the Leveling Power During the Electrodeposition of Copper", *Zashchita Metallov* (1972), Vol. 8, No. 3, pp. 338-342).

King et al. and Gerenrot et al. are as applied for the same reasons as discussed in I. above and incorporated herein.

Process

IV. Claims **12 and 23** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Landau** (US Patent No. 6,261,433 B1) in combination with **Gerenrot et al.** ("Effect of the Structure of Carbocyanine Dyes on the Leveling Power During the Electrodeposition of Copper", *Zashchita Metallov* (1972), Vol. 8, No. 3, pp. 338-342).

Landau teaches a process for producing a semiconductor integrated circuit

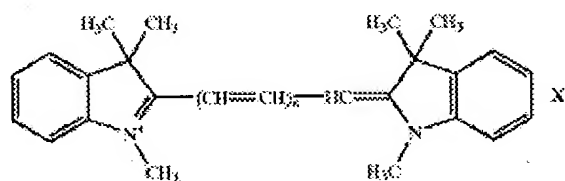
device comprising the steps of:

(a) providing an insulating layer **16** having features **17, 32** on the top of the major surface of a semiconductor wafer **14** which has a plurality of circuit element areas **15** formed (Fig. 1A),

(b) depositing a barrier metal layer **20** and a seed metal layer **21** on the bottoms and the side surfaces of said features and on the top surface of said insulating layer (Figs. 1B and 1C), and

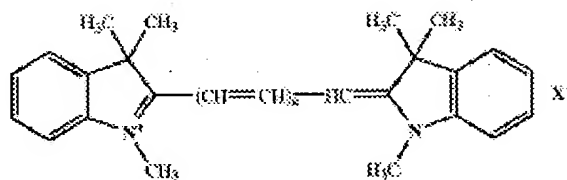
(c) filling the inside of said features with copper **22** by electroplating with a copper electroplating bath comprising a solution containing copper ions (col. 18, lines 17-21), at least one electrolyte (col. 18, lines 22-30) and polyethers (col. 18, lines 40-52) [col. 2, line 15 to col. 3, line 45; and Figs. 1A-1E].

Landau does not teach wherein the solution contains at least one of the compounds represented by the following general formula:



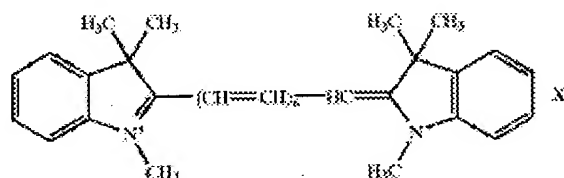
However, Gerenrot teaches a carbocyanine dye having the formula:

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as a leveling agent in a copper electroplating solution (abstract; and page 339, Table, dye No. 5).

Thus, the invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the copper electroplating bath of Landau by using a carbocyanine dye having the formula:



as the leveling agent because Landau teaches that levelers are included in his copper electroplating baths because they improve the deposition thickness uniformity (col. 18, lines 53-63).

Thus, a conventional leveling agent such as the carbocyanine dye taught by Gerenrot (abstract; and page 339, Table, dye No. 5) used in the copper electroplating solution of King would have been functionally equivalent and well within the skill of the artisan to use.

As to wherein concentration of said at least one of the compounds represented by the general formula (I) in the electroplating bath, at said bottoms of said features, during the process, is less than that at a top of said features, the Landau combination appears to disclose a process at least in a similar manner as instantly claimed. There does not appear to be any method limitations set forth in the instant claims to distinguish the instant claims from the prior art. Therefore, it would have been within the skill of the art to expect that the concentration of said at least one of the compounds represented by the general formula (I) in the electroplating bath, at said bottoms of said features, during the process, is less than that at a top of said features, unless proven otherwise.

V. Claims **14 and 24** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Landau** (US Patent No. 6,261,433 B1) in combination with **Gerenrot et al.** ("Effect of the Structure of Carbocyanine Dyes on the Leveling Power During the Electrodeposition of Copper", *Zashchita Metallov* (1972), Vol. 8, No. 3, pp. 338-342).

Landau and Gerenrot et al. are as applied for the same reasons as discussed in **IV.** above and incorporated herein.

VI. Claim **21** is are rejected under 35 U.S.C. 103(a) as being unpatentable over **Landau** (US Patent No. 6,261,433 B1) in combination with **Gerenrot et al.** ("Effect of the Structure of Carbocyanine Dyes on the Leveling Power During the Electrodeposition

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of Copper", *Zashchita Metallov* (1972), Vol. 8, No. 3, pp. 338-342).

Landau and Gerenrot et al. are as applied for the same reasons as discussed in IV. above and incorporated herein.

Landau does not teach wherein said at least one of the compounds represented by the general formula (I) suppresses the electroplating reaction and is consumed as the electroplating reaction proceeds, and has a diffusion rate lower than a rate of reaction thereof during the process.

However, the invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made because it has been held that a newly discovered use or function of components does not necessarily mean the system is unobvious since this use or function may be inherent in the prior art. *Ex parte Pfeiffer* 135 USPQ 31.

VII. Claim **22** is are rejected under 35 U.S.C. 103(a) as being unpatentable over **Landau** (US Patent No. 6,261,433 B1) in combination with **Gerenrot et al.** ("Effect of the Structure of Carbocyanine Dyes on the Leveling Power During the Electrodeposition of Copper", *Zashchita Metallov* (1972), Vol. 8, No. 3, pp. 338-342).

Landau and Gerenrot et al. are as applied for the same reasons as discussed in VI. above and incorporated herein.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

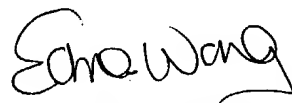
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Edna Wong whose telephone number is (571) 272-1349. The examiner can normally be reached on Mon-Fri 7:30 am to 5:00 pm, alt. Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the

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Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


Edna Wong
Primary Examiner
Art Unit 1753

EW
March 19, 2004